

# Diamond Booster RF

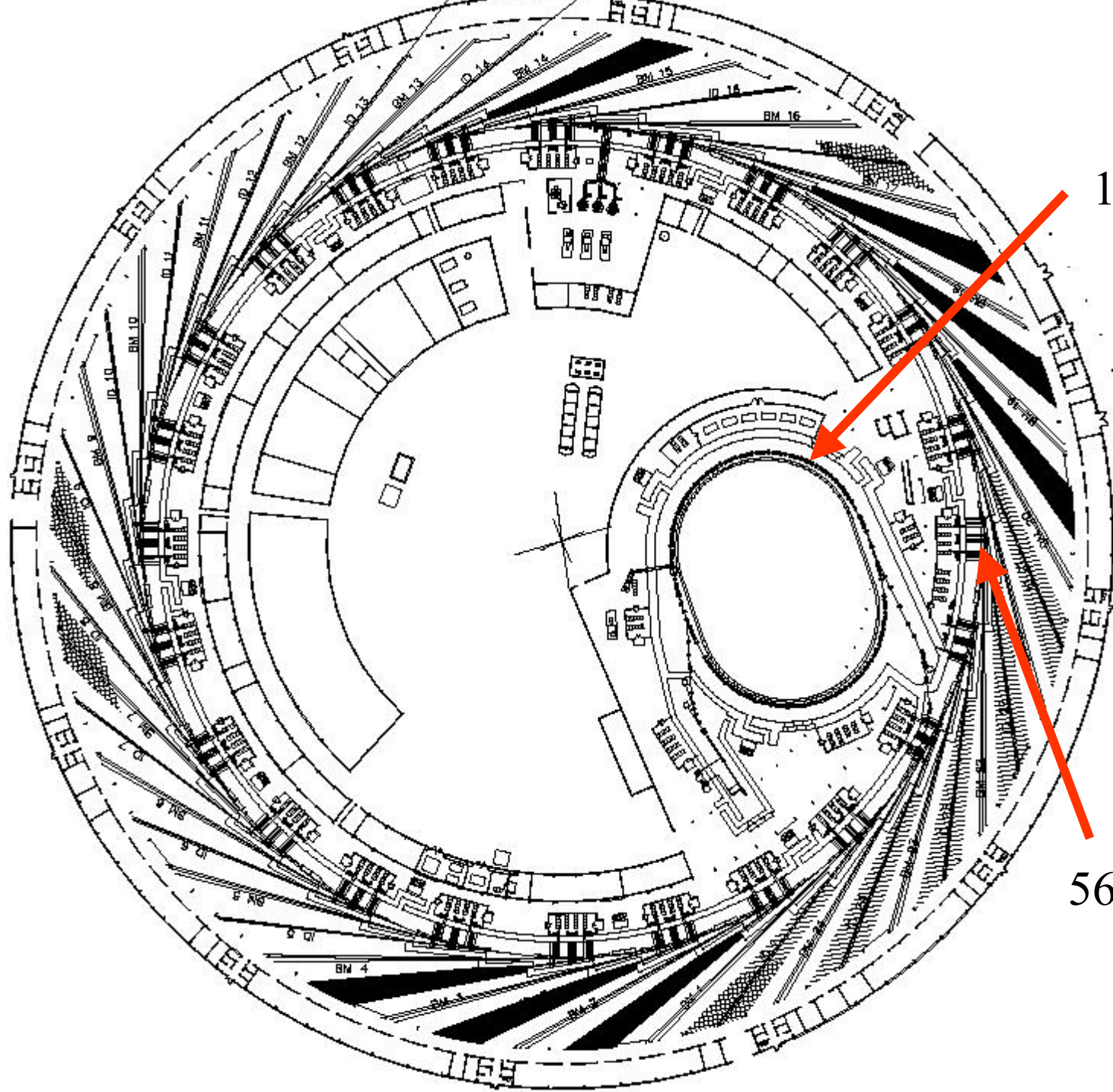
Andrew Moss

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# Introduction

- 3Gev Booster
- Linac at  $\sim 100\text{Mev}$
- Extraction at 3GeV
- Top up operation
- Racetrack design based on the SOLEIL Booster
- Maximum emittance of 150 nm rad
- Good injection/extraction system
- 1 RF cavity
- Design still very fluid



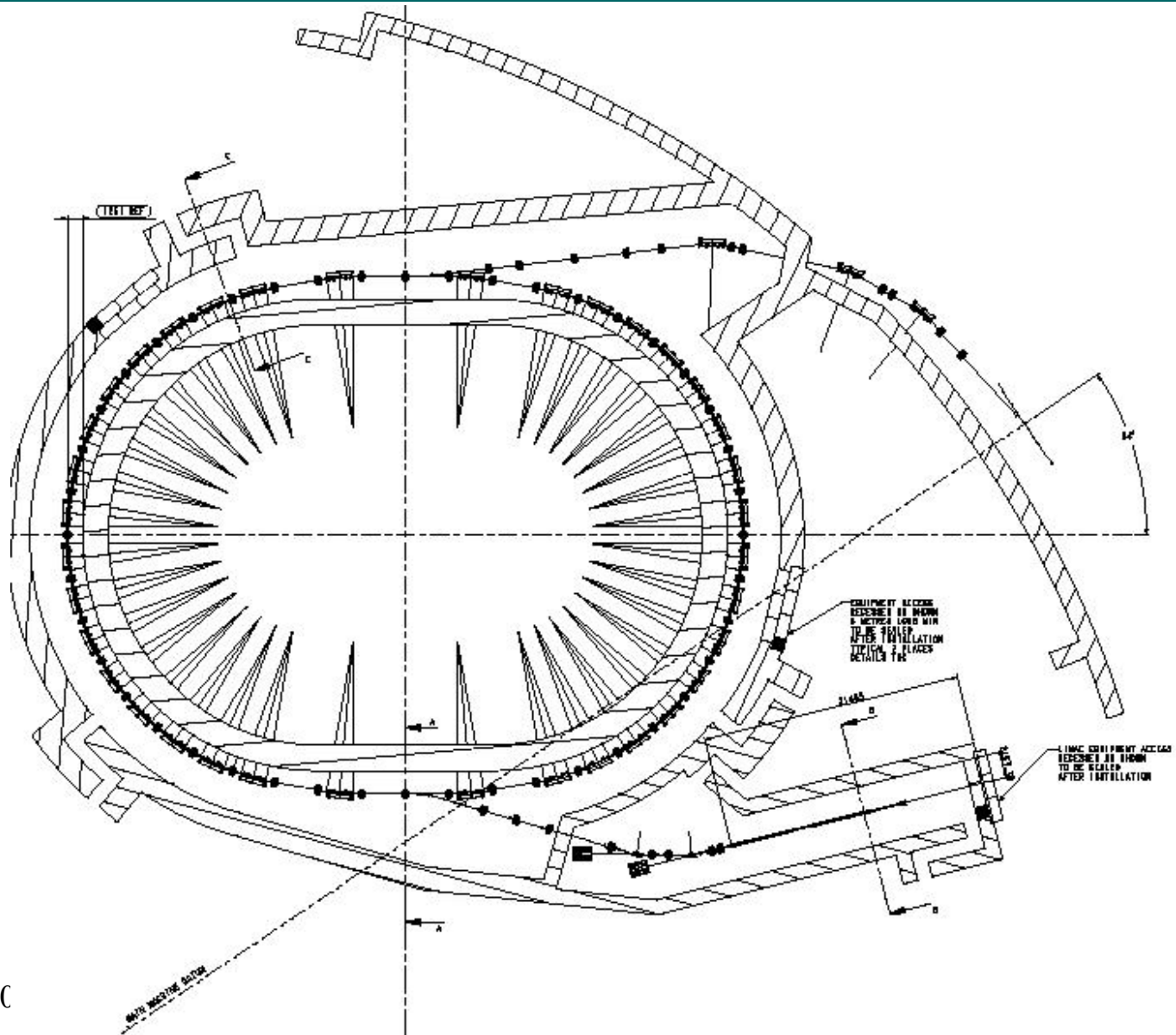
158M

562 M

No

# Booster lattice

- 2-fold symmetric missing dipole FODO lattice
- 22 cells with 36 dipoles, 8 missing dipole sections
- 44 quadrupoles
- 44 sextupoles
- 22 dual plane BPMs
- 22 H correctors, 22 V correctors

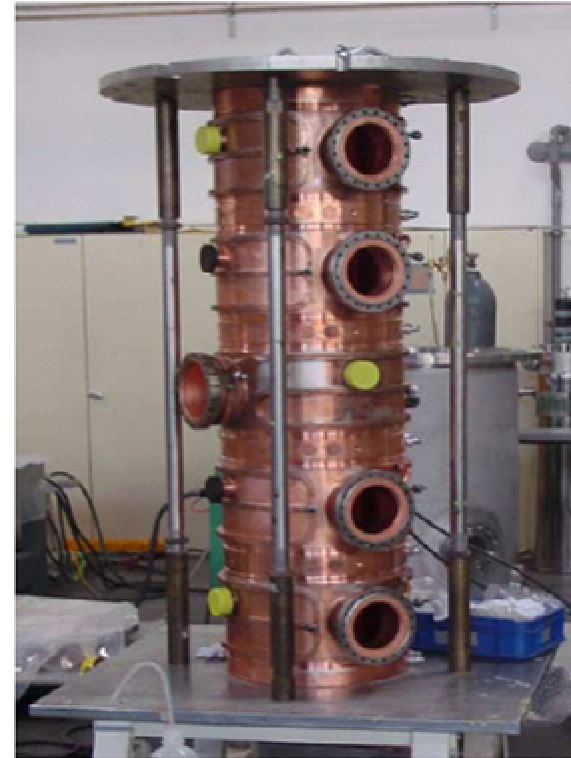


# Facts and figures

- Beam energy 3GeV
- Beam current 3.17mA
- Loss/turn 0.57MeV
- Harmonic No. 286
- 158.4 metres Circ
- Cells 22
- Super periods 2
- $F_s$  35kHz
- Quantum lifetime  $\sim 45$
- Momentum compaction 0.0285
- Cav coupling 1.11
- Cav volts 1.1MV
- 499.654 MHz
- RF power 54kW
- Cav power 48kW
- Beam power 5.7kW
- Rep rate 5Hz

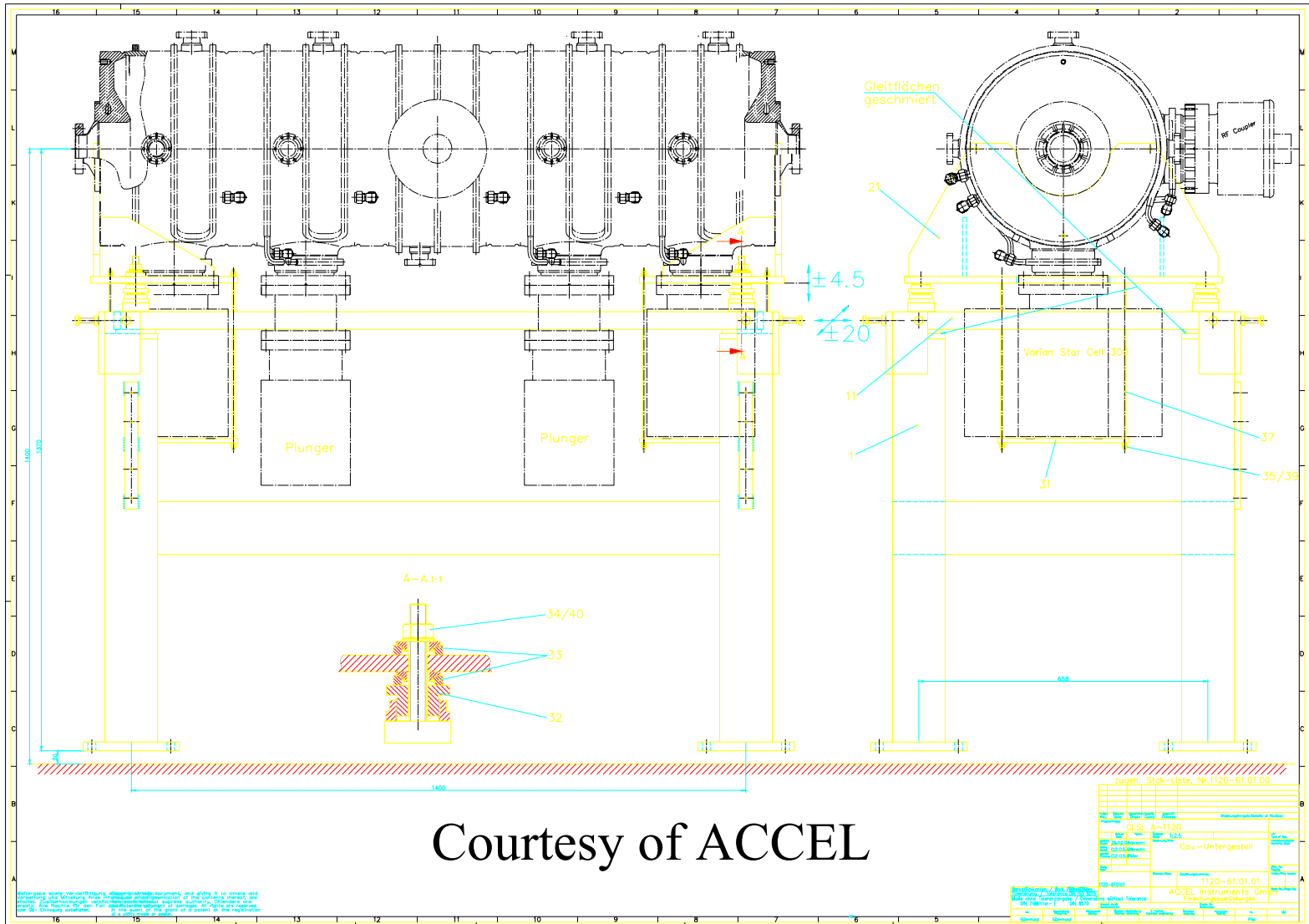
# Cavity

- Commercial Petra 5 cell cavity
- Multi-cell cavity, very high R/Q
- Manufactured by ACCEL
- Used at CLS and soon at ELLETRA
- Proven record, over 200 cavities in operation at DESY
- Control electronics can be supplied



Courtesy of ACCEL



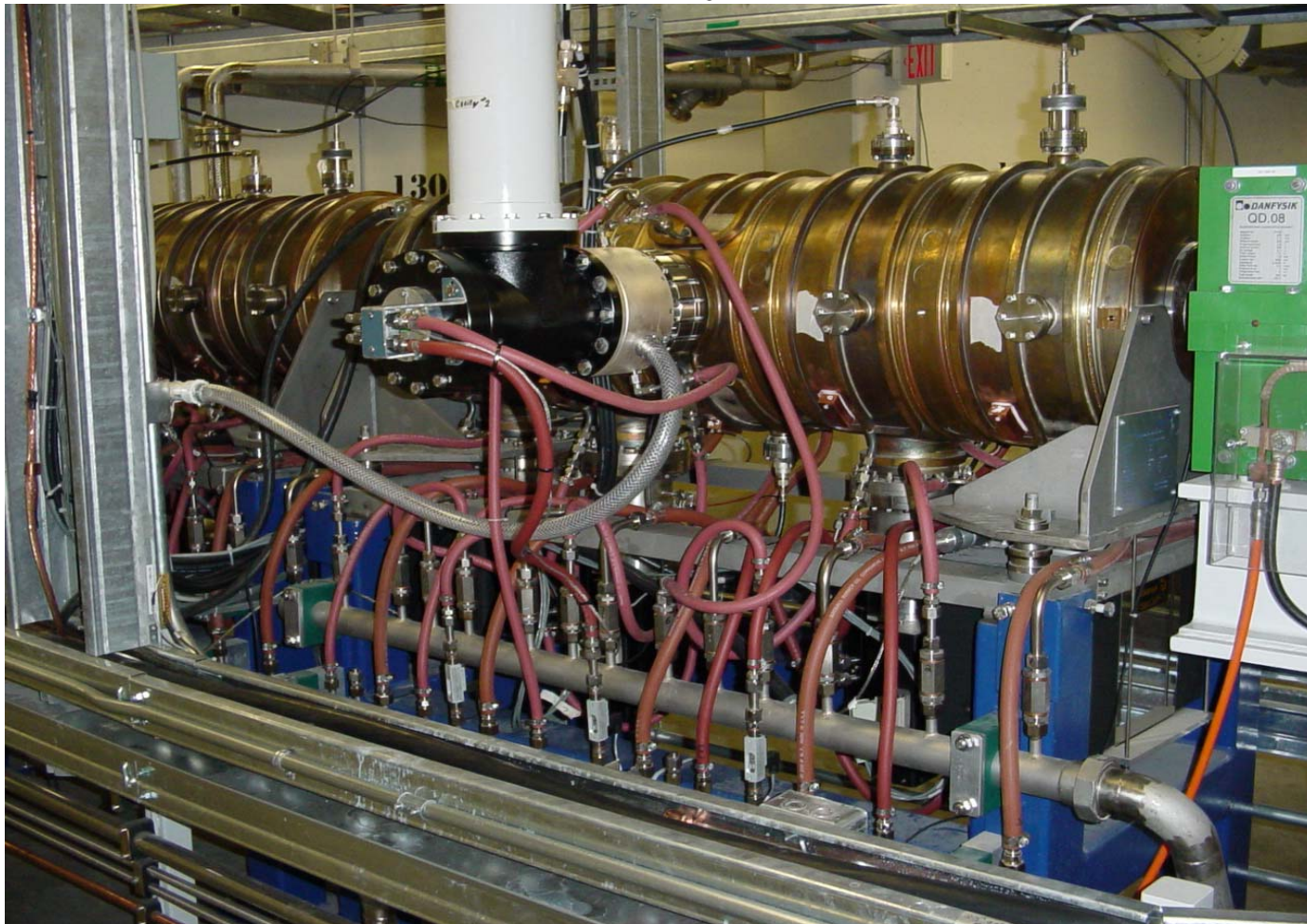


Courtesy of ACCEL

# PETRA cavity

- 500MHz @ 30C
- Shunt impedance  
>14.5M $\Omega$
- $Q_0$  29,000
- RF Power min 65kW
- Amplitude field  
flatness +/- 5%
- RF coupler 65kW CW  
limit
- Beam tube flange DN63  
CF
- 4 N type pickups
- Cooling water pressure 4-  
8 bar
- Cooling water flow 100  
L/min
- Water temperature  
stability +/- 1C

# Petra cavity at CLS



Nov/2002



RF  
transmission

Nov/2002



# RF power supplies

- 60kW RF supply
- 5 Hz rep rate
- RF drive modulation
- TV klystron
- IOT
- Transmitter based power supply

# IOT

- 80kW
- 35kV 3Amp
- 160mm dia, 800mm long, 23Kg weight
- ~85% efficiency
- 300W drive
- 23dB gain



# Klystron

- 70kW
- 28kV 5.4 Amp
- 2 Meters tall
- 50-65% efficiency
- 30W drive
- 40dB Gain



# Tube choice

- Both the Klystron and IOT are readily available from manufactures at this power level
- Off the shelf transmitter systems based on TV using both types of tubes
- Unlikely that system spares/tubes of this size will become unavailable in the lifetime of Diamond



# CLS power supply



Nov/2002

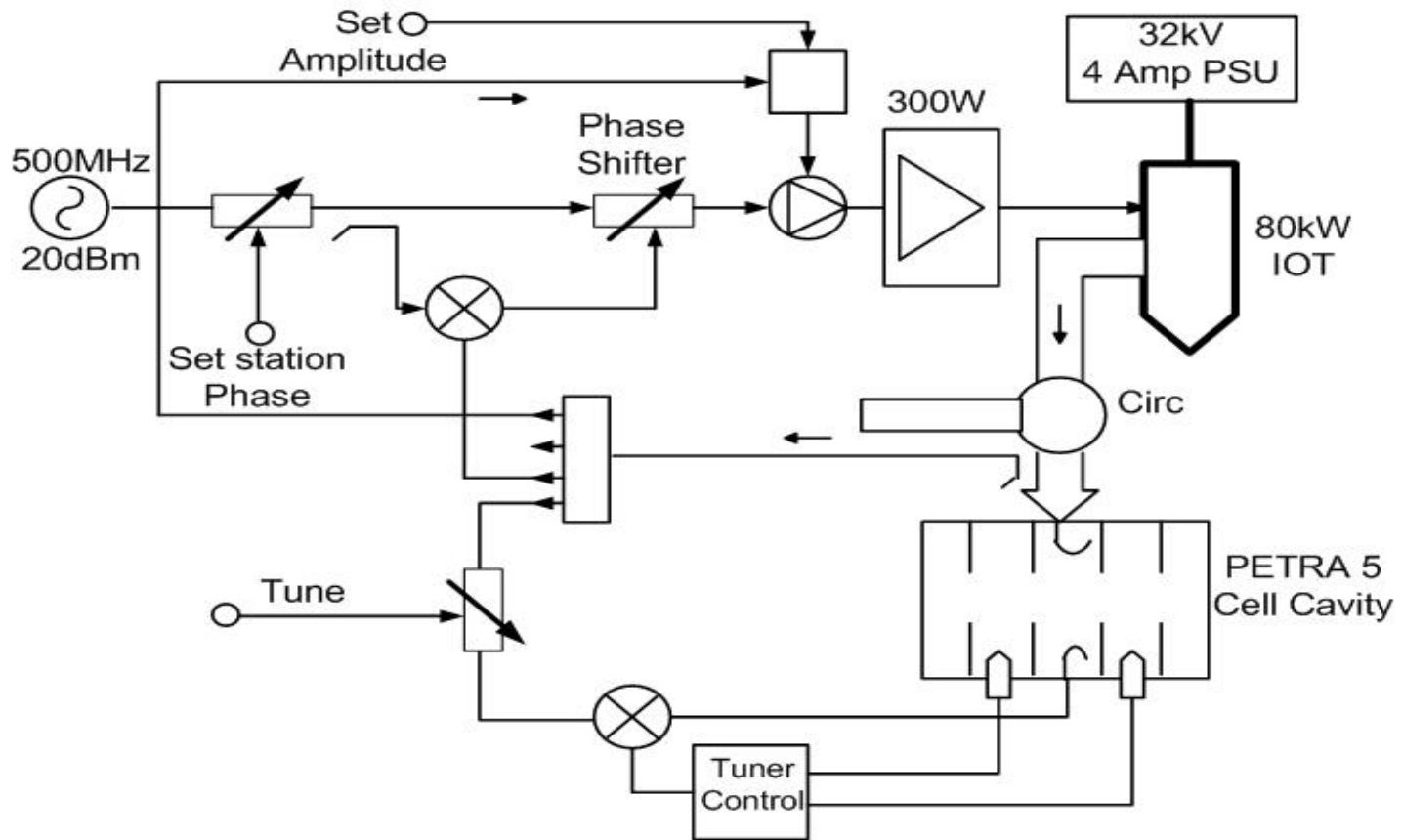


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- Harris transmitter
- 70kW IOT



# RF Path

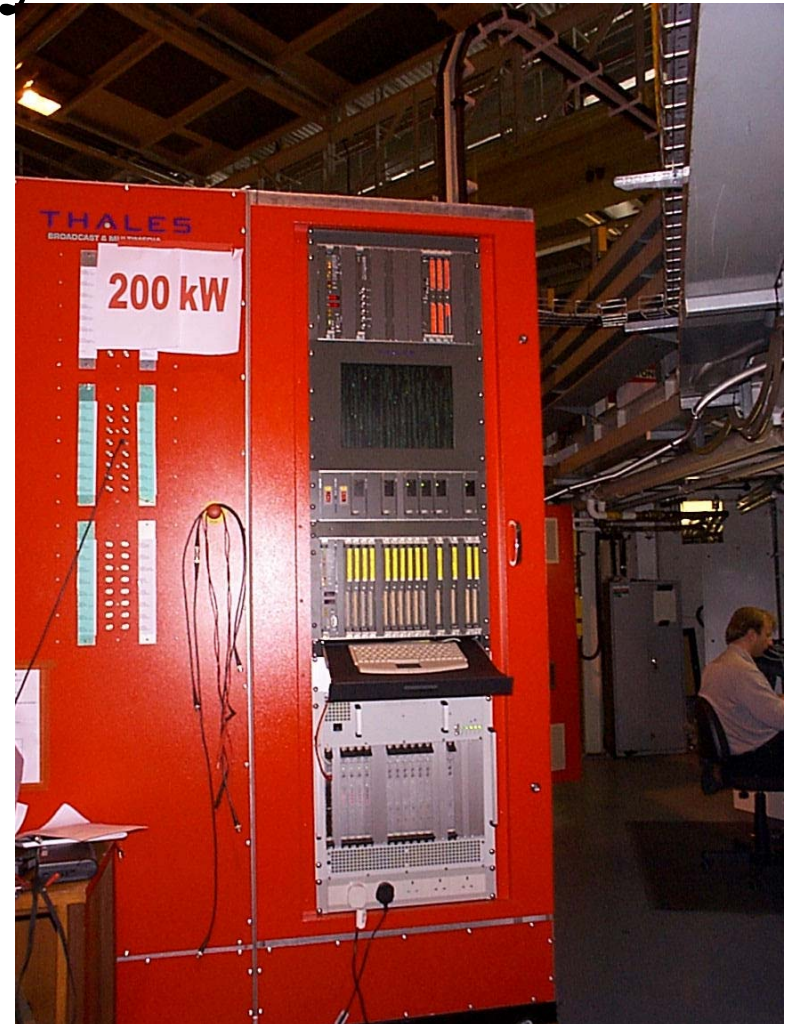


# Feedback systems

- Available with the cavity from ACCEL
- Comparison between centre cell and the incident RF
- Regulation is by two tuners on cells 2 & 4 driven by one phase feedback loop
- Also amplitude flatness is compared and adjusted automatically
- Amplitude loop driven from centre cell, adjusts RF drive to klystron

# Control system

- Stand alone control system is very desirable
- EPICS based system will easily interface to the Diamond control system
- Good control system can double the cost of the power supply



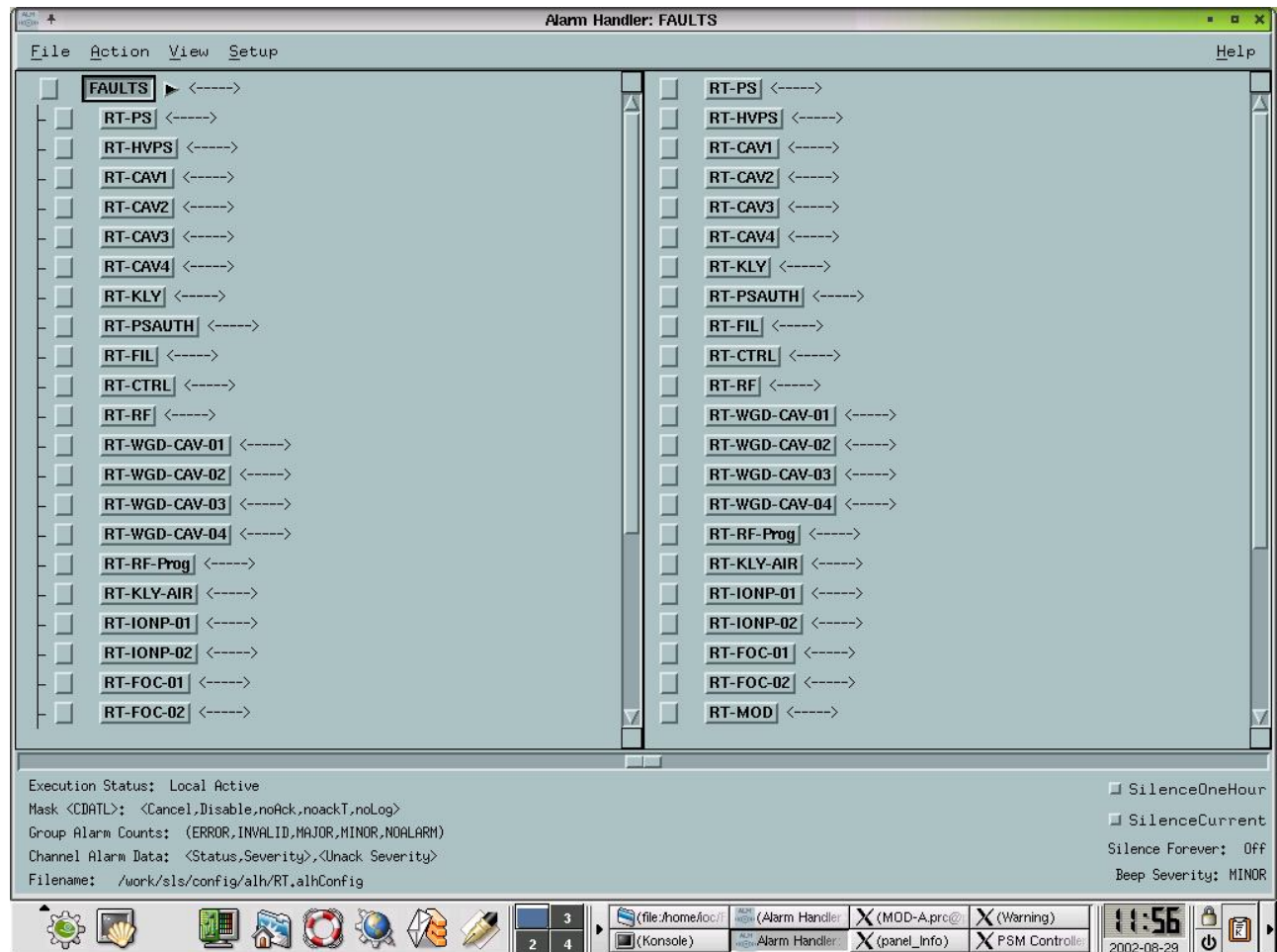
# User interface

The screenshot displays the 'PSM Controller V1.00 (unit : RT)' interface. It features several key components:

- Alarm Handler:** A floating window with a 'FAULTS' button.
- Data Tables:** Three tables showing real-time measurements for KLYSTRON, RF, and CAVITY-0.
- Operating Mode Selector:** A row of buttons labeled M0 through M6, with M1 currently selected.
- Mode Legend:**
  - M0: forbidden, all outputs zero
  - M1: KLY1 normal operation
  - M2: KLY1 run on Test Load with Isolator
  - M3: KLY2 normal operation
  - M4: KLY2 run on Test Load with isolator
  - M5: single PS Test
  - M6: PS Testing (klystron not connected), no interlocks!!!
- PSM State Machine Controller:** A vertical stack of buttons including ZERO, OFF, AUX ON, Standby, HV ON, BEAM ON, and RF ON.
- missing signals to enable next state:** A large empty box for monitoring signal status.
- next state:** A button showing 'ENABLED'.
- Unit Information:** 'Unit : RT' and 'Thu 02-Aug-29 11:54'.
- Navigation:** A bottom bar with buttons for Cooling, Klystron, LLRF, Cavity, Test, Options, and Quit.
- Taskbar:** Shows the system tray with a clock at 11:54, date 2002-08-29, and several open application windows.

# Alarm recording

- Alarm recording
- Event capture
- Logging





# Top up operation

- Top up very likely for Diamond
- RF/Injection system must be able to run 24Hrs a day ~5000Hrs/year
- Specification will set ratings for components at 50% of the normal running condition
- Semiconductor junction temperatures must not exceed 100 C
- Top is not required from day 1

# Timescales

- Specification for Booster RF system will be written by February 03
- Cavity, amplifier, control system, will be under one tender/ part tenders will be acceptable ?
- European tender, order during June 03>
- Install August 04 for one year
- Commissioning with beam September 05>